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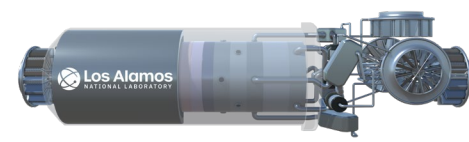
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Nuclear Safeguards: Stewardship, Innovation and Frontiers

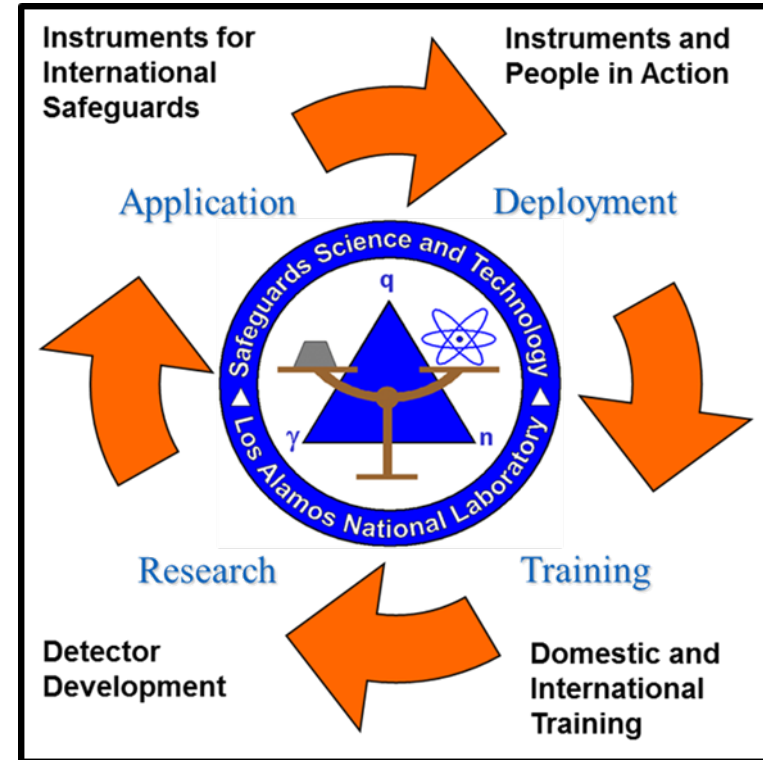
Rollin Lakis (NEN-1)
Safeguards Science and Technology
Nuclear Engineering and Nonproliferation



Nuclear Safeguards- Stewardship

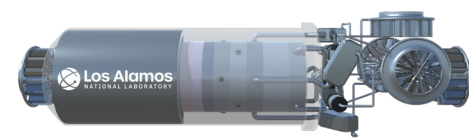


- LANL exercises full technology lifecycle for the development and deployment of nuclear safeguards (nonproliferation) systems and methods.
 - Five decades of international engagement.
 - Expert knowledge of fuel cycle processes and trends.
 - Extensive domestic and international training (~23 classes/year).
 - Passive Nondestructive Assay of Nuclear Materials (PANDA). MCNP cook book.
 - New tools to the international community.
 - High quality information Analysis



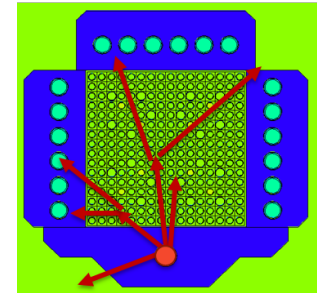
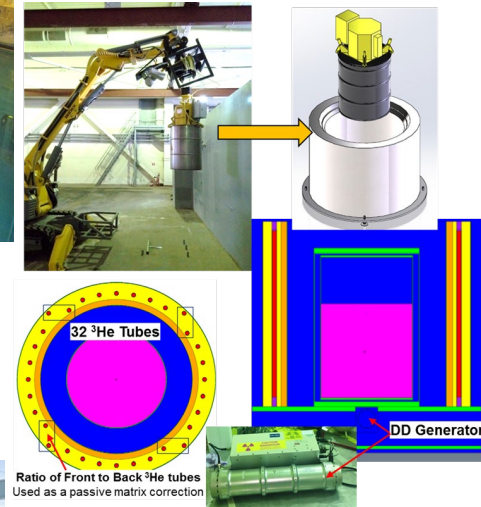
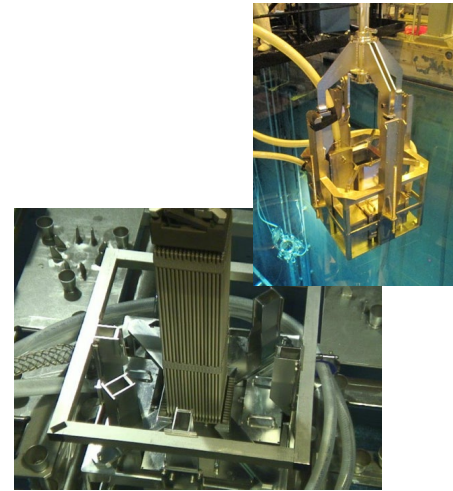


Nuclear Safeguards- Innovation



Instruments and Methods

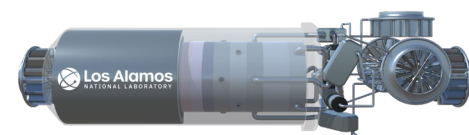
- Spent Nuclear Fuel Assay
 - Differential Die-Away (DDA)
 - Differential Die-Away Self-Interrogation (DDSI)
- Fresh Fuel Production and Verification
 - Unattended Cylinder Verification Station
 - Uranium Neutron Collar–Light Water Reactor Fuel Collar (UNCL)
- Waste
 - Chernobyl Waste Assay Detector (CWAD)





Dynamic Material Control (DYMAC)

Director's Initiative- Lab Agenda Focused



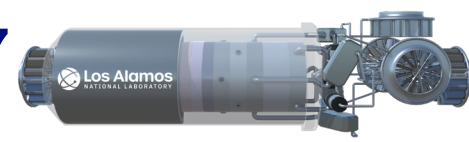
LDRD provides enabling research for Weapons Production mission

- DYMAC LDRD- Fundamental and crosscutting technological challenges.
- DYMAC Weapons Production- Enable an agile and efficient nuclear production mission through improved nuclear material accountability in PF-4.

SIMULTANEOUS EXCELLENCE	1.0 NUCLEAR SECURITY	2.0 MISSION-FOCUSED SCIENCE, TECHNOLOGY & ENGINEERING	3.0 MISSION OPERATIONS	4.0 COMMUNITY RELATIONS
Strategic Objective (10–20 years)	Excellence in Nuclear Security	Excellence in Mission-Focused Science, Technology & Engineering	Excellence in Mission Operations	Excellence in Community Relations
Critical Outcomes (5–10 years)	Design, produce, and certify current and future nuclear weapons and reduce global nuclear threats	Deliver scientific discovery and technical breakthroughs that support DOE and NNSA missions	Execute sustained operations that are reliable and responsive to mission needs	Sustain and enhance LANL's partnership with the community across the Northern New Mexico region
Major Strategic Initiatives (1–5 years)	<div>1.1 Execute LANL's Manufacturing mission to deliver 30 plutonium pits per year</div> <div>1.2 Transform nuclear weapons warhead design and production</div> <div>1.3 Anticipate threats to global security; develop and deploy revolutionary tools to detect, deter, and respond</div> <div>1.4 Continue to support the W88 Alt 370, Alt 940, and the B61-12 LEP</div> <div>1.5 Assess the stockpile as it ages and project weapon systems lifetimes</div>	<div>2.1 Refresh and refine the LANL capability pillar framework</div> <div>2.2 Advance accelerator science, engineering, and technology to enable future stewardship capabilities</div> <div>2.3 Advance the frontiers of computing to exascale and beyond</div> <div>2.4 Assert leadership in the national quantum initiative</div> <div>2.5 Develop and implement an integrated nuclear energy and materials initiative</div> <div>2.6 Develop and implement an integrated initiative for plutonium and actinide missions</div>	<div>3.1 Change organizational culture with an emphasis on organizational learning</div> <div>3.2 Improve integrated planning across priority mission activities and infrastructure</div> <div>3.3 Address critical issues related to NMCA, nuclear safety, criticality safety, and waste</div> <div>3.4 Implement systematic process improvement to drive increased rigor and efficiency in work execution</div> <div>3.5 Enhance quality of work life, workforce planning, and training and development</div>	<div>4.1 Continue commitment to the community with educational, economic, and philanthropic investments of time and resources</div> <div>4.2 Strengthen pipelines and partnerships to build workforce of the future</div> <div>4.3 Enhance small business participation in executing LANL scope across all directorates</div>



The Original DYMAC Implementation 1977



Dynamic Material Control

- Created under leadership of Bob Keepin.
- Designed for the new PF-4 facility in 1977-1978.
- Applied expertise of NEN-1 and predecessor groups.
- Installed 31 NDA instruments on the process floor for use by the operator.

Bob Keepin



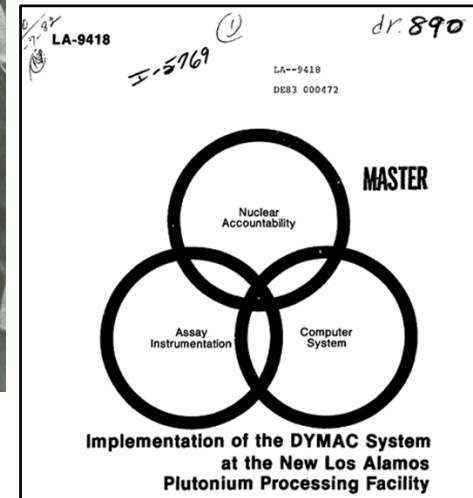
Sigvard Eklund
DG of IAEA



Norris Bradbury
LASL Director

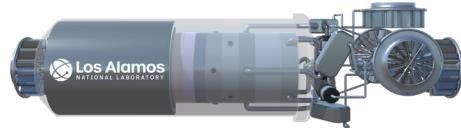


1969

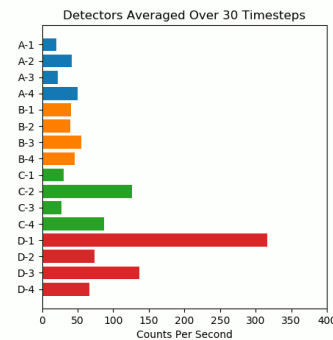
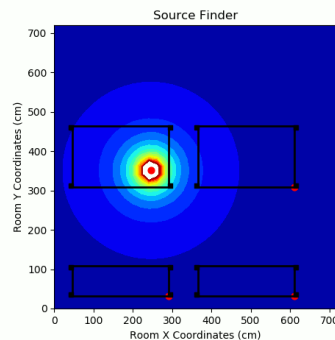
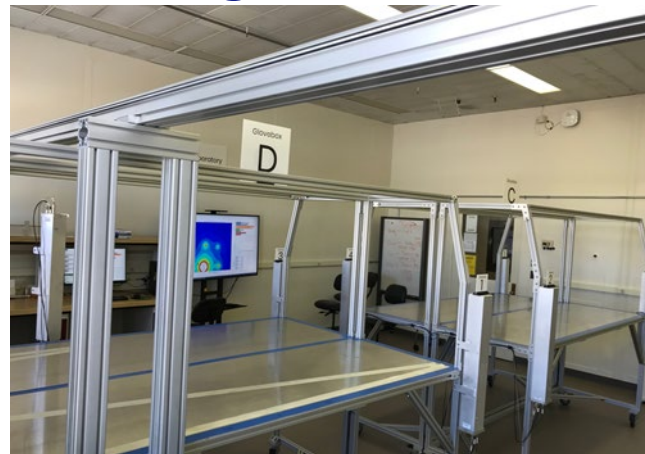




The LDRD Focus is on Most Fundamental Technical Challenges



- Dynamic background measurement and mitigation high performance detectors.
- Systematic and quantitative assessment of NMCA key measurement points to justify, prioritize and implement NDA or other physical characterization investments.
- Improved nuclear safety and security through near real time nuclear material situational awareness.

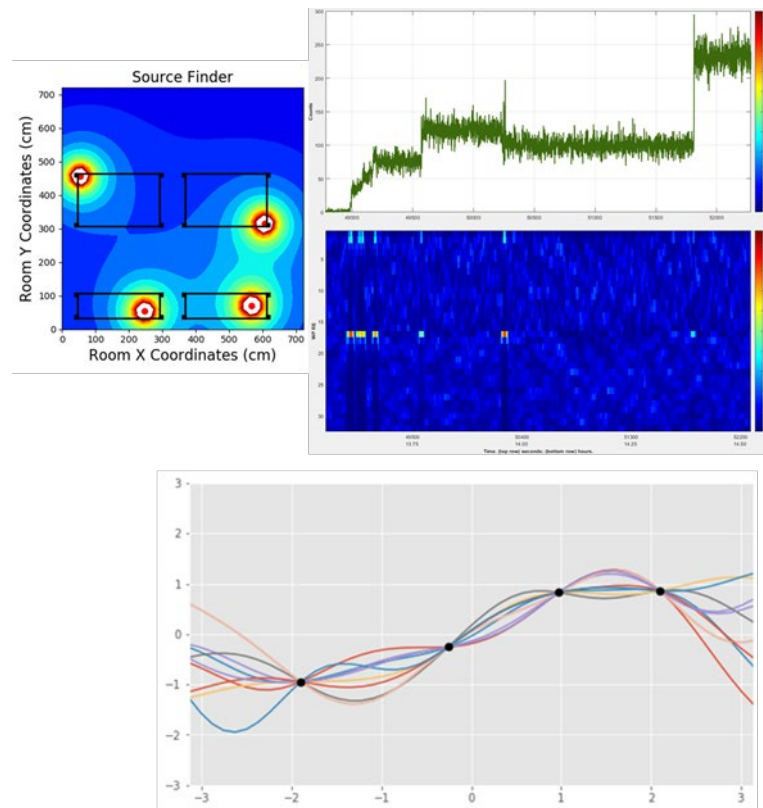




The LDRD investment has created a highly leveraged impact in LANL programs very quickly

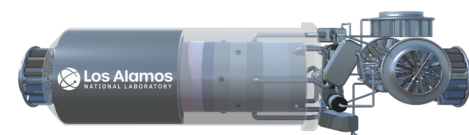


- Innovative and improves efficiency/reliability of many domestic and international nuclear material management issues.
- The approach enables agile manufacturing while satisfying growing needs for enhanced nuclear process control.
- The most innovative people are focused on the most difficult challenges. NEN, CCS, ISR and E represented.
- Data science (ML) efforts are building on science based stockpile stewardship with perspective that is only at LANL.
- Students and collaborators that typically would not support nuclear production environments are important contributors.
- The LDRD investment has created a highly leveraged impact in LANL programs very quickly.



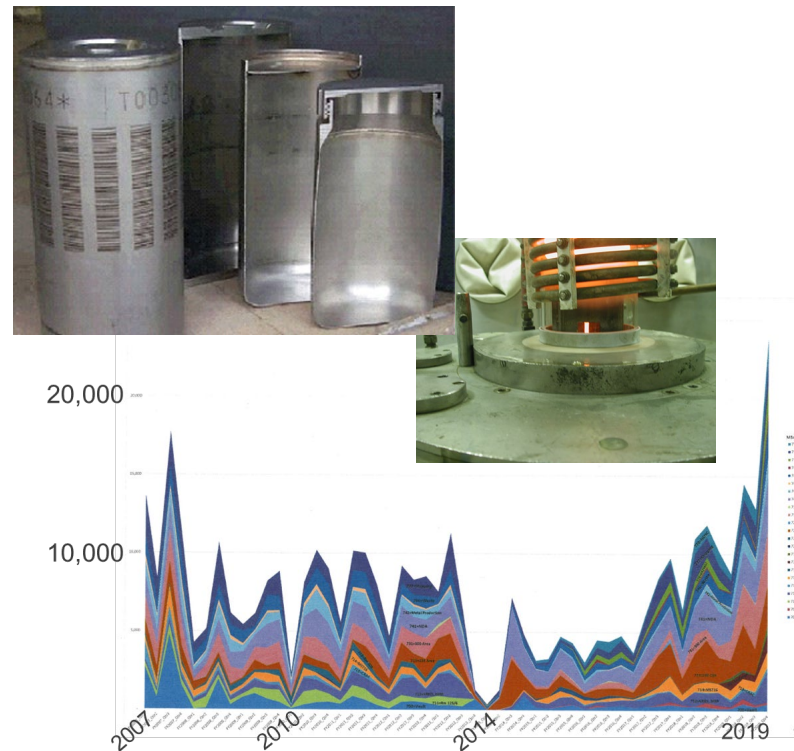


DYMAC Weapons Production Program Goal is to Develop Near-Real-Time Material Accountancy



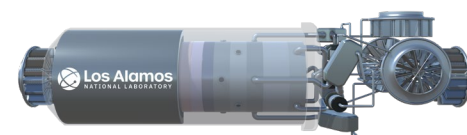
~\$5.6M = Pu Sustainment + Strategic Materials Sustainment, Material Recycle & Recovery Program (MR&R)

- Enable an agile and efficient nuclear production mission through improved nuclear material accountancy in PF-4.
- Support near-real-time material accountancy using advanced instrumentation, process aware models and predictive analytics.
- Be the nexus of NMCA capability:
 - Radiation transport, nondestructive assay (NDA) and nuclear material control and accounting (NMCA)
 - Instrument engineering
 - Advanced statistics and data analysis
 - Process modeling
 - Team with SAFE-NMCA to address crosscutting system improvements
 - Team with Actinide Operations to support individual unit operations and MBAs

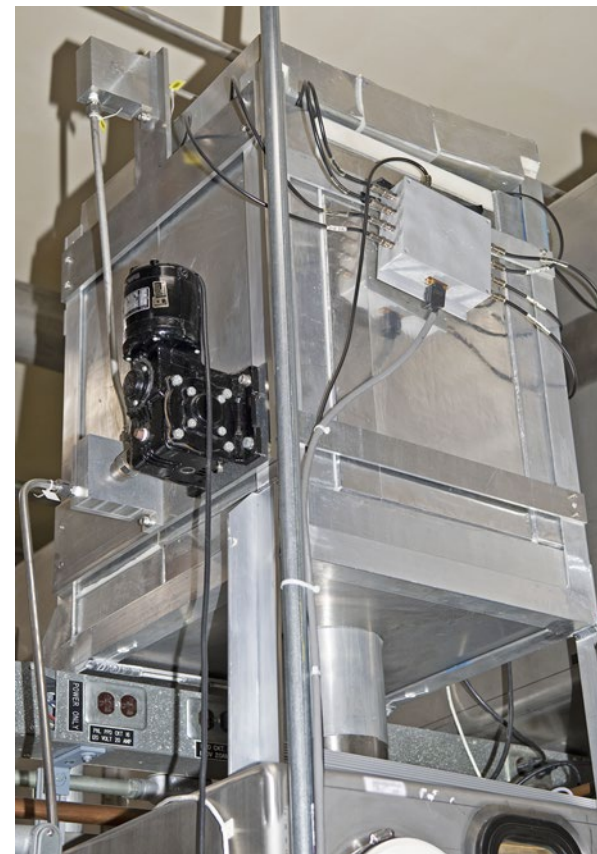




Making a Difference in PF-4

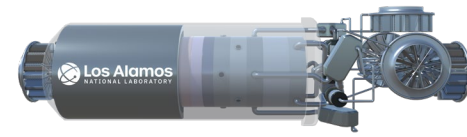


- New TRU waste glovebox system in 400-Area
 - New TNC (additional \$1.8M)
 - Optimize WIPP drum loading to reduce total drums by 1/3 or more
- ARIES oxide re-measurement campaign
 - Work towards neutron NDA of product oxide
- RFID inventory tag system
- ^{238}Pu waste NDA
- DYMAC 1.0 equipment inventory
- Background measurement campaign and instrument
 - DYMAC Background Characterization Module (DBCM)





TRU Waste Operations- Fewer Drums and Less Work



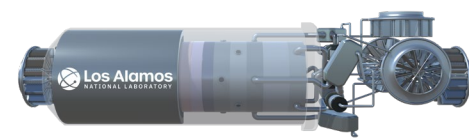
- Current Practice
 - Waste from a single MBA is bagged-out into a waste drum, assayed for NMCA and sent for WIPP acceptance measurements.
- DYMAC Improvement
 - Waste from a single MBA is assayed in-line.
 - Waste from multiple MBAs are combined into a single drum.
 - Each drum is filled to WIPP acceptance capacity.



Compared to

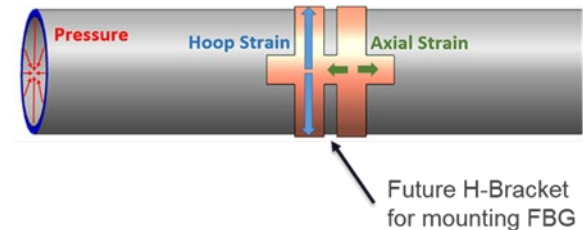
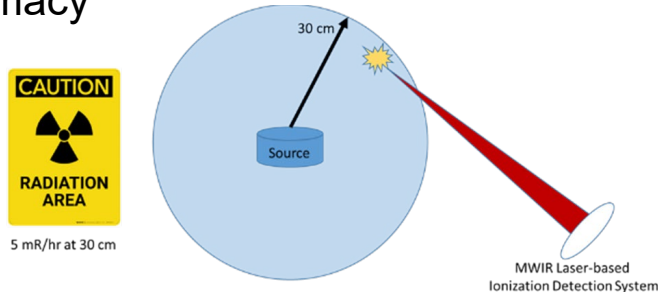
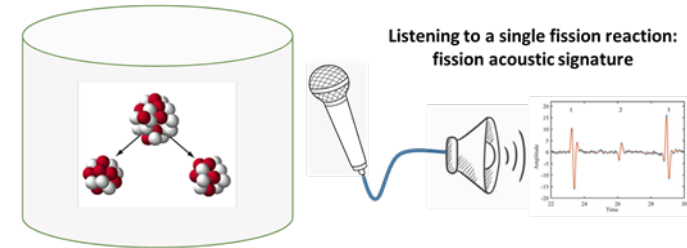
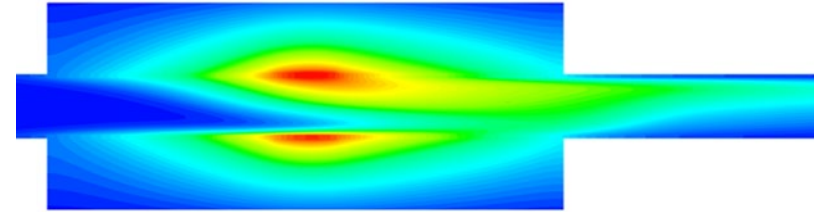


NPI Division finds- 30% reduction in effort
Total number of drums significantly reduced



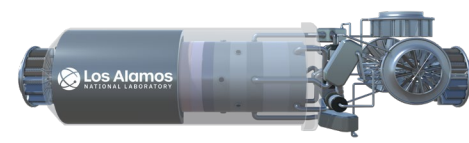
Technology and people for the future

- LDRD
 - DYMAC Director's Initiative
 - Microcalorimetry
 - Fission Acoustic Signature Discovery
 - Thermal Mass Flow Meter (UF6)
 - Noninvasive Pressure Measurement
- Defense Nuclear Nonproliferation R&D (NA-22)
 - Remote Supremacy





Summary- Stewardship, Innovation and Science



- We are deliberate stewards for the legacy of nuclear safeguards.
 - Instrument technology.
 - International and domestic implementation.
 - Training (~23/year).
- Innovation in all these areas leads to improved performance of nuclear safeguards systems and nonproliferation security.
- Collaborative frontier science with LDRD and Program leads to new scope and increased capability for dynamic mission support.

